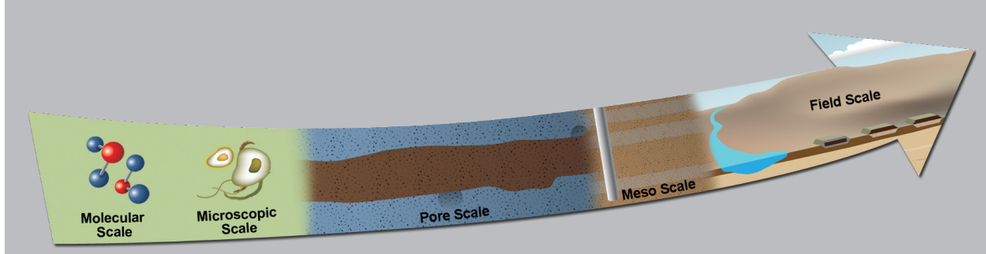
Seventeen major sites located across the United States were once used for nuclear material production, weapons development, and weapons testing. Several of these sites are now contaminated with radionuclides, metals, or hazardous chemicals. These contaminants create a significant environmental liability that the Department of Energy (DOE) is dedicated to cleaning up.

To date, DOE has made significant progress remediating these sites by embracing a mission based on reducing risk and reducing environmental liability through fundamental scientific understanding and applied technologies. DOE intends to accelerate this progress through the integrated efforts of its Office of Science (SC), Office of Environmental Management (EM), National Nuclear Security Administration (NNSA), and Oak Ridge Site Operations (ORO).



Approach

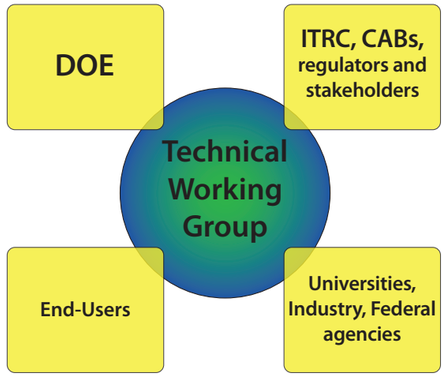
For DOE to successfully address remaining cleanup problems, it will require 1) partnering and leveraging with other relevant organizations and 2) integrating basic science and needs-driven research activities with DOE cleanup operations to facilitate the transition of scientific results into applied solutions.

The initiative will provide innovative tools and approaches for locating, characterizing, predicting, and monitoring the flux of mercury and other key industrial contaminants that are found in surface water, groundwater, and biota at the three DOE facilities in Oak Ridge. Additionally the initiative will support the evaluation of the potential impact of D&D activities on changes in the subsurface flow paths and contaminant releases.

The knowledge gained through the work of the initiative will be used to transfer basic science knowledge and use-inspired research findings to practical solutions that can be deployed by site contractors at the Oak Ridge Reservation and across the entire DOE complex.

The initiative at Oak Ridge—the Remediation of Mercury and Industrial Contaminants Applied Field Research Initiative—is tasked with developing cost-effective technical solutions for:

- Point source remediation and water treatment,
- Source zone identification, characterization, pathway analyses, and soil treatment
- Conceptual and numerical modeling of contaminant fate and transport.



Applied Field Research Initiative

Remediation of Mercury and Industrial Contaminants

Located on the Oak Ridge Reservation (ORR) in Oak Ridge, Tennessee, the Remediation of Mercury and Industrial Contaminants Applied Field Research Initiative (RoMIC-AFRI) was established to protect water resources by addressing the challenge of preventing contamination.

The initiative at Oak Ridge is a collaborative effort that leverages DOE investments in basic science and applied research and the work of site contractors to address the complex challenges in the remediation of legacy waste at the Oak Ridge Reservation.

Challenge

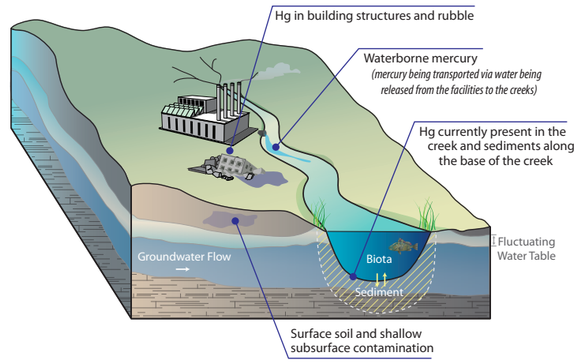
Releases of mercury during operations at the Y-12 National Security Complex during the 1950s and early 1960s resulted in contamination of soil and groundwater within the facility, and subsequent transport from these sources resulted in contamination of East Fork Poplar Creek (EFPC), a portion of the Bear Creek watershed.

Remediation efforts, which began in the 1980s, have reduced waterborne mercury concentrations both within the Y-12 facility and in the EFPC ecosystem, but elevated levels of mercury remain in the soil, sediment, water, and biota. The processes that control the fate and transport of mercury near the facility are extremely complex. The hydrological, geochemical, and microbial interactions between the subsurface and surface water systems are not well understood.

DOE has planned future remedial actions and activities that are expected to substantially reduce mercury flux to the creek in the long term. However, DOE is concerned that remediation and construction activities during decontamination and decommissioning (D&D) could induce changes in subsurface flow paths that might result in unintended short-term releases to downstream waters.

Additionally, on-site safeguard and operation activities at Y-12 are barriers to systems-based characterization efforts. For effective environmental management and site closure decision making relative to mercury contamination at the Y-12 Complex, a systems-based understanding of the facility's mercury source areas, processes, likely transport pathways, and flux into the creek is needed.

In addition to mercury contamination at Y-12, ORR has numerous other intractable environmental problems with industrial contaminants (such as U, Tc, Sr, Cs, and other radionuclides, metals, nitrate, PCBs, VOCs and DNAPL) migrating from a complex subsurface system composed of fractured rock and karst present beneath former burial grounds and disposal cribs. Given the diversity of subsurface contaminants and the complex hydrogeology, an understanding of the various contaminant movement pathways and potential application of innovative technologies and approaches will be critical to effective remediation.



U.S. DEPARTMENT OF ENERGY

2011-G00318/cae

For more information, contact:
Eric Pierce
Oak Ridge National Laboratory
1 Bethel Valley Road, MS 6038
Oak Ridge, TN 37831
pierceem@ornl.gov
(865) 574-9968

Kurt Gerdes
DOE-EM
Office of Groundwater and Soil Remediation
kurt.gerdes@em.doe.gov
(301) 903-7289

OAK RIDGE National Laboratory

SRNL™ SAVANNAH RIVER NATIONAL LABORATORY Operated by Savannah River Nuclear Solutions, LLC

The mission of the Remediation of Mercury and Industrial Contaminants Applied Field Research Initiative is to control the flux of contaminants in soil and water environments for the purpose of protecting surface water, groundwater, and ecological receptors.

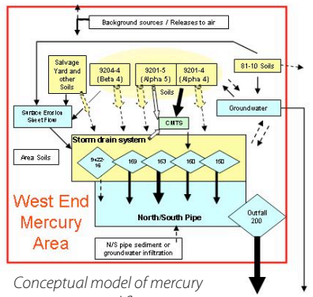
Applied Field Research Initiative

Remediation of Mercury and Industrial Contaminants

Contaminant Distribution

Lead Agency: DOE-EM-32

- Conceptual model developed to describe and identify key mercury source zones at a DOE facility.
- Similar models are planned for other facilities and watersheds.
- Important tool for communicating with regulators and stakeholders and for defining research needs.



Conceptual model of mercury source areas and flux

Identifying Mercury Source Zones

Lead Agency: DOE-EM-32

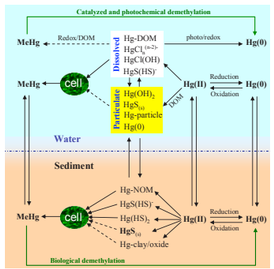
- Develop and field test innovative tools and approaches to locate and identify mercury source zones.
- Develop and evaluate laboratory-based techniques to characterize and speciate mercury source zones and investigate transport pathways.

Mercury contaminated surface sediments

Understanding Mercury Transformation

Lead Agency: DOE-SC

- Elucidate the rates, mechanisms and controls of abiotic and microbial processes affecting mercury speciation and transformation.
- Resolve what and how critical mercury precursors are produced and subsequently passed into cells and become methylated.
- Investigate microbial subcellular mechanisms including acquisition, transfer and transformation of major mercury species and methylmercury.
- Determine the net balance of methylation and demethylation.



Schematics of abiotic and microbial transformation pathways between inorganic mercury and methylmercury

Understanding Contaminant Fate

Lead Agency: DOE-ORO; DOE-NNSA

- Monitor fish and other biota to evaluate changes in bioaccumulation and remedial action performance.
- Evaluate the role of legacy contamination in downstream environments to develop abatement and long-term stewardship strategies.

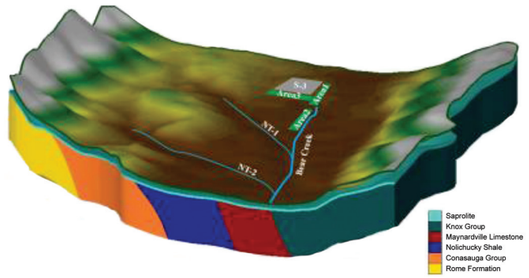
Mercury mesocosms

Rockbass

Predicting Contaminant Behavior and Remediation Performance

Lead Agency: DOE-EM-32

- Develop a state-of-the-art scientific tool and approach to predict contaminant movement in natural and engineered systems.
- Capability will streamline transition of scientific results into applied solutions across DOE Complex.



3D image of Bear Creek Hydrology

D&D Mercury Initiative

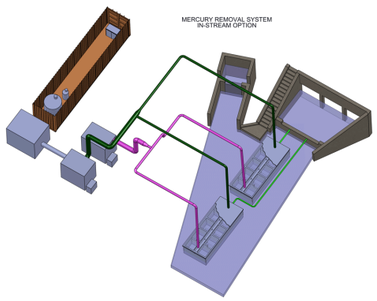
Lead Agency: DOE-ORO/DOE-EM-44

- Develop and evaluate detection and characterization technologies to accurately analyze concentrations of mercury beneath surfaces and in equipment and piping.
- Develop and demonstrate debris separation processes and/or technologies to allow segregation of mercury contaminated debris above disposal limits.
- Develop and demonstrate improved mercury treatment technologies for remediating large quantities of mercury debris.

Reducing Mercury Flux to the Environment

Lead Agency: DOE-EM-32

- Developing and evaluating various treatment technologies to remove or reduce mercury in water, soil, and sediment.
- Evaluating the impact of chemical additions on mercury removal and corresponding effect on the surrounding ecology.



Potential Stannous Chloride Treatment Option

Remediating Other Challenging Contaminants

Lead Agency: DOE-EM-32

- DOE sites are complex industrial sites with multiple contaminants and potential transport pathways.
- Provide technical assistance and support for evaluating alternative solutions and approaches to remediating contaminants.